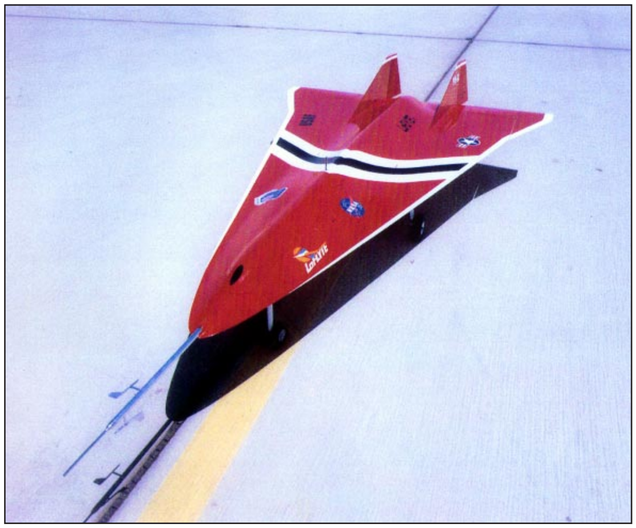
ALGORITHM INSTRUMENTAL IN NEURAL NETWORK FLIGHT CONTROL DESIGN



Payoff

The algorithm called Drive-Reinforcement Learning enabled researchers to design a neural network flight control system that, conceptually, will enable a Low Observable Flight Test Experiment (LoFLYTE) unmanned vehicle to make a smooth transition between subsonic and hypersonic flight. The LoFLYTE vehicle was recognized by Popular Science magazine in December 1996 as one of its 100 "Best of What's New" because of the promise neural networks hold for aviation.

Accomplishment

An algorithm developed in-house by the Sensors Directorate has led to research sponsored by the Air Vehicles Directorate and Propulsion Directorate for the development, by Accurate Automation Corporation, of a novel flight control and hypersonic flowpath control systems to be used on an Air Force-NASA LoFLYTE prototype uninhabited vehicle. This mathematical process, called Drive-Reinforcement Learning, gives the flight control system's computers the capability of learning from experience.

Background

Advances have been made with computer learning technology which now can challenge human champions in games such as chess and backgammon. In the mid-1980s, scientists at the Sensors Directorate developed an algorithm called Drive-Reinforcement Learning that gives computers the capability of learning from experience. Working with neural networks since the late 1980s, Accurate Automation Corporation first used the Drive-Reinforcement Learning technique with computers that operated a prototype of the space shuttle's robot arm. Because of this successful demonstration, they are now using Drive-Reinforcement Learning in the neural network hardware of an uninhabited air vehicle (UAV) sponsored by the Air Force and NASA. This UAV, LoFLYTE, is a wedge-shaped hypersonic wave-rider configuration with twin vertical tails and moving wing tips called tiperons. The LoFLYTE vehicle configuration incorporates a 2-D hypersonic flowpath and expansion ramp nozzle, and is designed to fly at Mach 5 by riding on top of its primary shock wave instead of behind it. The Air Force Research Laboratory is sponsoring multiple research efforts using neural network approaches to hypersonic flowpath development and flight control development respectively. The hypersonic Mach numbers present a whole new set of challenges to the flight control designer including precision integration of engine control with vehicle flight path control, solving extreme changes in aerodynamic and mass associated trim changes, severe aerothermoelastic effects on vehicle structural characteristics and control effectiveness, and unique control requirements for engine unstarts and flameouts. Neural networks offer a promising potential to meet these challenges since augmented control functions may be readily learned and adapted to on-board and real-time by the neural network flight control system.